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MUTUALLY TOLERANT HOST AND DONOR TYPE IMMUNOLOGICALLY COMPETENT CELLS IN MOUSE RADIATION CHIMERAS

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ABSTRACT

Host type immunologically competent cells were found in 4 out of 15 LAF_1(host)-C3H (donor) long-lived radiation mouse chimeras. Three of these 4 chimeras also had donor type lymphoid cells. Therefore, the host and donor immunocompetent cells must have co-existed in a state of mutual homograft tolerance. Of the remaining 11 chimeras tested, 6 did not exhibit host type immunocompetent cells, while 5 showed questionable host-derived immunological activity. Donor immunocompetent cells were detected in a total of 4 of the 15 LAF_1-C3H chimeras. Host type (i.e., strain A) immunocompetent cells were detected also in two A-LAF_1 radiation chimeras. On the other hand, 10 C3H-$C3D2F_1$ radiation chimeras apparently did not contain host-derived immunogenic cells.

The presence of hematopoietic cells of host origin was detected in 4 out of 15 LAF_1-C3H radiation chimeras. Host-derived hematopoietic cells were not detected in the A-LAF_1 radiation chimeras, and only 1 of the 10 C3H-$C3D2F_1$ radiation chimeras had host hematopoietic tissue. Therefore, within the limits of the test system employed the hematopoietic cells in the remaining chimeras must therefore be predominantly of donor origin.

SUMMARY

The Problem:

It has been determined that long-lived homologous radiation chimeras, produced by injecting allogenic bone marrow cells into mice which were exposed to a lethal dose of X radiation, contain immunologically competent (henceforth called immunocompetent) cells derived from the donor marrow. However, the presence in such chimeras of cells arising from irradiated host tissues has not been established. The present report is concerned with the detection of immunocompetent cells of host type and also of host type hematopoietic cells in radiation chimeras.

The Findings:

Lymphoid tissues from individual LAF_1 mice, which had been previously exposed to 880 rad of X rays and injected with bone marrow cells from C3H strain donors, were tested for the presence of host (LAF_1) derived immunocompetent cells. Four out of 15 of these chimeras had host immunocompetent cells and three of these 4 also had donor type lymphoid cells. Of the remaining 11 chimeras tested, 6 apparently did not have host type immunocompetent cells, while 5 had questionable host derived immunological activity. Donor immunocompetent cells were detected in all but 4 of the 15 chimeras.

Other chimeras, in which the host was a parental strain and the marrow donor the F_1 hybrid, were also studied. Two lethally irradiated A strain mice injected with LAF_1 hybrid marrow were found to have A (i.e., host) type immunocompetent cells present 3 months later. On the other hand, 10 lethally irradiated C3H mice injected with $C3D2F_1$ hybrid marrow apparently did not have host derived immunogenic activity 4 months later.

The presence of hematopoietic cells of host origin was detected in 4 out of 15 LAF_1-C3H chimeras. Host derived hematopoietic cells were not detected in the A-LAF_1 chimeras and only 1 of the 10 C3H-$C3D2F_1$ chimeras had host hematopoietic tissue.

It is concluded: 1) That host type immunocompetent and hematopoietic cells exist in some, though not all radiation chimeras. 2) A spectrum of mixtures of donor and host genotypes probably exists in the lymphoid, and perhaps the hematopoietic tissues of these chimeras. A few animals may no longer be chimeric, i.e., complete reversions, others may have both host and donor cell types in varying proportions, and still others may have only donor type cells. 3) In the cases where both host and donor immunocompetent cells exist together, a state of mutual tolerance must also exist. 4) Immunological activity on the part of the host in these long-lived radiation chimeras is infrequent. The irreparable effects of radiation together with graft-versus-host immunological reactions may act in supressing the host.

INTRODUCTION

It has been shown that the lymphoid tissues of allogenic radiation chimeras contain immunologically competent cells (henceforth called immunocompetent cells) of donor origin (1) On the other hand immunocompetent cells of host origin have not been detected in such chimeras (2,3,4), although their presence has been suggested by Gengozian and Makinodan (5) and by Hollingsworth (6) The findings in this report demonstrate the presence of host type immunocompetent cells in some LAF_1-C3H long-lived chimeras, and these cells are shown to co-exist with immunocompetent cells of donor origin in an apparent state of mutual tolerance. Data demonstrating the presence of host hematopoietic cells in a few radiation chimeras is also presented.

MATERIALS AND METHODS

Radiation Chimeras: Allogenic radiation chimeras were prepared by exposing mice to 880 rad of X radiation (a dose 100 rad above LD_{99}) and inoculating them intravenously with 4 to 8 x 10^6 bone marrow cells from normal allogenic donors. The radiation factors were as follows: 250 kvp Westinghouse Therapy Unit operating at 15 ma and using 0.5 mm Cu and 1.0 mm Al filters; T.S.D. was 100 cm and the dose rate was 30 rad/min. Forty-five mice, placed in individual lusteroid tubes, were exposed at one time on a platform rotating at 3.5 r.p.m. Following irradiation and bone marrow injections, the mice were housed 2 to a cage and during the first week postirradiation their drinking water

contained Neomycin sulfate* (100 mg %) and Polymyxin B sulfate** (890 units per ml). After 3 weeks the chimeras were relocated in cages holding up to 10 animals.

The bulk of the data given in this report involve LAF_1-C3H chimeras, that is, $(C57L \times A)F_1$ hybrids (so called LAF_1 mice bred at this Laboratory) which were exposed to 880 rad of X radiation and given marrow cells from normal C3H/Crgl donors. The chimeras used in this study were survivors from a population of which approximately 60% had succumbed to secondary disease. At the time of sacrifice (12 to 15 months after marrow injection), these chimeras were apparently healthy.

Additional data were obtained from the A/HeJax mice exposed to 770 rad and injected with bone marrow cells from LAF_1/Nrdl donors (A-LAF_1 chimeras), and from C3Hf/Crgl mice exposed to 840 rad and injected with $(C3H \times DBA/2)F_1$/Jax ($C3D2F_1$) bone marrow (C3H-$C3D2F_1$ chimeras). In these 2 combinations the bone marrow recipients were not strictly a parental strain of the respective marrow donor since they were bred in different laboratories. A high incidence of late deaths, presumed to be due to secondary disease, was noted in the latter two groups of chimeras.

Detection of Host Type Immunocompetent Cells: The presence of host immunocompetent cells in chimeric lymphoid tissue was determined by one

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of several test systems. When the host was a monozygous strain, the mortality resulting from the parental-F_1 hybrid syndrome was used as the test system (7). Cells (15 to 25 x 10^6) from a chimera's lymphoid tissue (usually spleen) were injected intraperitoneally into sublethally irradiated (500 rad) F_1 hybrids of which one parent was of the same strain as the chimera host while the other parent was a third unrelated strain. For example, with A-LAF_1 chimeras, (BALB/c x A)F_1 hybrids (CAF_1) were used as test animals and with C3H/f-C3D2F_1 chimeras, (C3H x BALB/c) F_1 hybrids ($C3BCF_1$) were used.

In testing the LAF_1-C3H chimeras, the lymphoid tissue cells were incubated in specific antiserum (anti-donor) and tested for any host immunogenic activity remaining. The antiserum was obtained from several strains of mice (LAF_1, A, CAF_1) hypersensitized against C3H tissue by 3 or more subcutaneous and intraperitoneal injections of C3H spleen homogenate. The injections were given at least 5 days apart and the antiserum, harvested 1 week after the last injection, was pooled and frozen for storage. The lymphoid cells from each chimera (usually from the lymph nodes) were mixed with the antiserum in the proportion of one ml of cell suspension (containing 25 x 10^6 cells per ml) per 1.5 to 2 ml of antidonor serum. This mixture was then incubated for 10 minutes at 37°C in a Dubnoff water bath shaker. The incubated mixture was diluted to 5 ml with Tyrode's solution and 1 ml aliquots, containing the equivalent of 5 x 10^6 nucleated cells,

were injected intraperitoneally into irradiated (880 rad) LAF_1 recipients which had just received 6 to 8 x 10^6 bone marrow cells from CAF_1 or BALB/c donors. The death of the test mice by 21 days, due to the rejection of the injected bone marrow cells, indicated the presence of immunocompetent host type (LAF_1) cells. As controls, known normal C3H or LAF_1 cells were incubated in the same manner and aliquots which contained 5 x 10^6 or 1 x 10^6 cells respectively were tested. In addition, another aliquot of the chimera's lymphoid cell suspension was tested directly without incubation.

A second test system was also used for detection of host immunocompetent cells in LAF_1-C3H chimeras. LAF_1 test animals were sensitized with a single injection of homogenized C3H spleen tissue(equivalent to 1/5 of a spleen administered both subcutaneously and intraperitoneally) and 1 week later they were irradiated (880 rad) and injected intravenously with 96 x 10^6 rat bone marrow cells. These mice then received intraperitoneally 5 to 15 x 10^6 cells prepared from each chimera's lymphoid tissue. Spleen cells from LAF_1 (1 x 10^6) or C3H (5 x 10^6) donors were injected into other test mice as controls. Again, death of the test mice by 21 days due to the rejection of the rat marrow indicated the presence of host immunocompetent cells.

Detection of Donor Type Immunocompetent Cells: The parental-F_1 hybrid test system, referred to above, was used for the detection of donor cells (1).

Determination of Host Type Hematopoietic Cells: Host type hematopoietic cells were determined by their ability to protect lethally irradiated, sensitized (anti-donor) mice. Sensitization was accomplished 1 week earlier by a combined subcutaneous and intraperitoneal injection of spleen homogenate from mice of the same strain as the marrow donor. Bone marrow cells from the 2 femurs of each chimera were collected and suspended in 0.7 to 0.9 ml of Tyrode's solution and 0.2 ml aliquots were inoculated intravenously into each of 2 sensitized (antidonor) recipients which had just received 880 rad of X rays. Other aliquots of 0.2 ml were injected into similarly irradiated but nonsensitized control mice. Survival of the irradiated, sensitized recipients indicated that host hematopoietic cells were present in the chimera's marrow.

RESULTS

Detection of Host Immunocompetent Cells by Treatment With Isoantiserum: Of the 11 LAF_1-C3H chimeras studied, 3 (chimeras No. 4,5, and 6) exhibited host LAF_1 as well as donor C3H type immunocompetent cells (Table I). Therefore the two lymphoid cell populations (donor and host) in these chimeras apparently existed in a state of mutual tolerance. Of the remaining 8 chimeras, 5 had no apparent host type activity, while in 3, the presence of LAF_1 cells was questionable. As can be seen from Table I, all of these chimeras, with the possible exception of No. 10 and 11, showed donor type cells. However, it should be noted that chimeras No. 9, 10, and 11 had retained

TABLE I

OCCURRENCE OF HOST AND DONOR IMMUNOLOGICALLY COMPETENT CELLS IN LYMPHOID TISSUES OF LONG-LIVED LAF_1-C3H RADIATION CHIMERAS

EXPERIMENT	CHIMERA NUMBER	HOST TYPE (LAF_1)*			DONOR TYPE (C3H)**	
		Mortality (no./total) antisera treated cells	untreated cells	Occurrence	Mortality (no./total)	Occurrence
A	1	1/5	5/5	absent	5/5	present
	2	0/5	5/5	absent	5/5	present
	3	3/5	5/5	(?)	5/5	present
	4	5/5	5/5	present	5/5	present
B	5	5/5	5/5	present	3/4	present
	6	5/5	5/5	present	4/4	present
	7	2/5	5/5	(?)	5/5	present
	8	0/5	5/5	absent	5/5	present
C•	9	0/5	4/5	absent	4/5	present
	10	1/5	3/5	(?)	2/5	(?)
	11	1/5	5/5	absent	3/5	(?)
		CONTROLS WITH LYMPHOID TISSUE OF KNOWN GENOTYPE				
A	C3H	1/10	5/5		10/10	
	LAF_1	5/5			1/10	
B	C3H	4/10	5/5		15/15	
	LAF_1	10/10			0/10	
C	C3H	3/10	6/6		11/11	
	LAF_1	9/10			0/10	

*Test system: Lymph node cells from each chimera were exposed in vitro to anti-C3H serum. The cells (5×10^6) were tested for remaining LAF_1 immunogenic reactivity by injection into irradiated LAF_1 recipients (880 rad) protected with CAF_1 bone marrow. In this system, 1×10^6 normal LAF_1 spleen cells are lethal.

**Test system: Spleen and lymph node cells (5 to 15×10^6) from each chimera were injected into sublethally irradiated (500 rad) $C3D2F_1$ hybrids.

•Chimeras 9, 10, and 11 had retained both C3H and LAF_1 skin grafts for 4 months but had rejected BALB/c grafts.

for 4 months both LAF_1 and C3H skin grafts but previously had rejected BALB/c homografts.

Detection of Host Immunocompetent Cells by Rejection of Rat Bone Marrow: Four chimeras were tested by this system (Table II). The lymphoid tissue cells from chimeras No. 12 and No. 15 were not active against the rat marrow indicating that there was no detectable host type LAF_1 immunocompetent cells present. However, all recipients of the lymphoid tissue of chimera No. 13 died, showing that host immunocompetent cells were present in this animal. The results for chimera No. 14 were inconclusive. As can be seen also in Table II donor type (C3H) lymphoid cells were found in chimeras No. 14 and No. 15, but in chimeras No. 12 and No. 13, their presence was questionable. All of these particular chimeras had retained LAF_1 and C3H skin grafts of 2 - 3 months duration at the time they were sacrificed. They also had rejected in a normal fashion foreign BALB/c skin homografts, indicating immunological competence.

Detection of Host Immunocompetent and Hematopoietic Cells in Chimeras of Other Strain Combinations: Two A-LAF_1 chimeras were sacrificed at 100 days and their pooled lymphoid tissues produced deaths on injection into CAF_1 hybrids which had been exposed to 500 rad of X rays (Table III). These results indicated the presence of immunologically competent host (A genotype) cells in at least one of these chimeras. In the test of hematopoietic cell genotype, no A

TABLE II

THE OCCURRENCE OF HOST AND DONOR IMMUNOLOGICALLY COMPETENT CELLS IN LYMPHOID TISSUES OF LONG-LIVED LAF_1-C3H RADIATION CHIMERAS (RAT MARROW REJECTION SYSTEM)

EXPERIMENT	CHIMERA NUMBER	HOST TYPE (LAF_1)* Mortality (no./total)	HOST TYPE (LAF_1)* Occurrence	DONOR TYPE (C3H)** Mortality (no./total)	DONOR TYPE (C3H)** Occurrence
D°	12	1/6	absent	2/5	(?)
	13	6/6	present	2/5	(?)
	14	2/6	(?)	5/5	present
	15	1/6	absent	5/5	present
	CONTROLS WITH LYMPHOID TISSUE OF KNOWN GENOTYPE				
	C3H	4/10		8/10	
	LAF_1	10/10		0/10	
	None	1/13			

*Test system: Lymphoid tissue cells (5 to 15 x 10^6) from each chimera were injected into presensitized (anti-C3H) LAF_1 recipients which had been exposed to 880 rads and given rat bone marrow.

**Test system: Lymphoid tissue cells (5 to 15 x 10^6) from each chimera were injected into C3D2F_1 hybrids exposed to 500 rad of X rays.

°All chimeras had retained both LAF_1 and C3H skin grafts for 2 to 3 months but had rejected BALB/c grafts.

TABLE III

OCCURRENCE OF HOST IMMUNOCOMPETENT AND HEMATOPOIETIC CELLS IN A-LAF$_1$ AND C3H-C3D2F$_1$ CHIMERAS

EXP.	CHIMERAS	NUMBER TESTED	OCCURRENCE OF HOST (A or C3H)	
			Immunocompetent Cells*	Hematopoietic Cells**
E	A-LAF$_1$	2(pooled)	present	absent
F	C3H-C3D2F$_1$	10	absent in each	present in one

*Test system: Lymphoid cells from the chimeras were injected into sublethally irradiated (500 rad) CAF$_1$ (Exp. E) or C3BcF$_1$ (Exp. F) hybrids. Death of these hybrids indicated the presence of host immunocompetent cells.

**Test system: Bone marrow cells from the chimeras were injected intravenously into irradiated (880 rad) LAF$_1$ recipients some of which had been presensitized (antidonor) and the rest were nonsensitized controls. The survival of the sensitized irradiated recipients indicated the presence of host hematopoietic cells.

type cells were found. These animals must therefore have had hematopoietic cells of donor (LAF_1) origin. Another group of 10 C3H-$C3D2F_1$ chimeric mice, tested individually at 4 months, showed no host (C3H) immunocompetent cells. In addition, all but one, were devoid of host type hematopoietic cells (Table III).

Detection of Host Type Hematopoietic Cells: In addition to the data for hematopoietic cells in A and C3H hosts given above, one experiment using LAF_1-C3H chimeras was carried out in which the presence of host type hemotopoietic cells as well as immunocompetent cells was tested on the same chimeras (Exp. A). These results along with those from other LAF_1-C3H chimeras are shown in Table IV. Host hematopoietic cells were detected in only 4 out of 15 chimeras; and of these the 4 in Experiment A showed no host type hematopoietic cells, including Chimera No. 4 which did have host type immunocompetent cells (Table I). Bone marrow cells from 8 additional chimeras, including Chimera No. 2 failed to protect nonsensitized recipients.

DISCUSSION

Host Immunocompetent Cells: In view of the known occurrence of reversions in irradiated mice protected with rat bone marrow (8,9) or with allogenic mouse marrow (10), the eventual recovery of host lymphoid tissue appeared to be a reasonable assumption (11). Gengozian and Makinodan (5) suggested from their data that hemagglutinins of host cell origin were present in mouse-rat chimeras. Hollingsworth (6) has

TABLE IV

OCCURRENCE OF HOST TYPE HEMATOPOIETIC CELLS IN THE BONE MARROW OF LONG-LIVED LAF_1-C3H CHIMERAS

EXP.	CHIMERA NO.	MORTALITY OF IRRADIATED RECIPIENTS (No./total)		OCCURRENCE OF HOST TYPE MARROW
		anti-C3H recipients	non-sensitized recipients	
A	1	2/2	0/1	absent
	2	2/2	1/1	(?)
	3	2/2	0/1	absent
	4	2/2	0/1	absent
C	16	2/2	0/1	absent
	17	2/2	0/1	absent
	18	2/2	0/1	absent
	19	2/2	0/1	absent
	20	2/2	0/1	absent
	21	1/2	0/1	(?)
	22	1/2	0/1	(?)
	23	1/2	0/1	(?)
	24	0/2	0/1	present
	25	0/2	0/1	present
	26	0/2	0/1	present
	27	0/2	0/1	present
	28	2/2	1/1	
	29	2/2	1/1	
	30	2/2	1/1	
	31	2/2	1/1	
	32	0/2	1/1	(?)
	33	1/1	1/1	(?)
	34	1/2	1/1	(?)
CONTROLS WITH MARROW CELLS OF KNOWN GENOTYPE				
	C3H	24/25	1/25	
	LAF_1	1/15	0/15	

*Test system: The bone marrow cells from the femurs of each chimera were injected into 3 irradiated (880 rad) LAF_1 mice, two of which had been sensitized (anti-C3H), and the other non-sensitized.

also suggested that some of the immune functions of the chimera, i.e., humoral antibody production, were attributable to the activity of host cells. However, in mice protected with allogenic fetal liver (2,4), with rat bone marrow (3) or with allogenic bone marrow (4), lymphoid cells of host genotype either were not found (by cytotoxicity tests) or were not active (by hemagglutinin activity).

The present data show that host type immunologically competent cells (i.e., able to reject foreign marrow cell grafts) are present in the lymphoid tissues of some, but apparently not all, long-lived LAF_1-C3H chimeras. These immunocompetent cells must be specifically tolerant of the donor genotype, since donor cells were present at the time of sacrifice. Tolerance on the part of immunocompetent donor cells with respect to the host has been established for long-lived LAF_1-C3H chimeras (1). Therefore, the host immunocompetent cells found in these chimeras apparently co-existed in a state of mutual tolerance with respect to cells of donor origin. Such a state of mutual tolerance has been suggested by our previous studies (1) and by those of Koller and Doak (12). Mutual tolerance has also been demonstrated recently in mice with neonatally acquired tolerance (13).

It appears from this and other reports (2,3,4) that host immunogenic activity is depressed or lacking in many allogeneic chimeras. This state may be due either to a qualitative or to a quantitative deficiency of host immunocompetent cells, or both. The results of Vos (2) indi-

cate a quantitative lack of host cells. In the present study, it is estimated that at least 20% of a chimera's lymphoid tissue cells must be of host type in order to obtain positive evidence of host immunogenic activity. It is conceivable that the irreparable effects of radiation, together with graft versus host reactions, may be responsible for a long-lasting depression of the host lymphoid system in LAF_1-C3H chimeras.

On the other hand, the evidence of mutual tolerance on the part of donor and host cells in radiation chimeras, with the persistence of an immune system of host origin, however feeble, also implies other possible mechanisms as follows: 1) suppression of both the donor and host homograft response towards one another by means of "clonal suppression" in the sense of the Burnet-Lederberg theory (14, 15); 2) immunological paralysis (16) of both donor or host due to excess of either host or donor transplantation antigens (both of these possible mechanisms of tolerance have been discussed previously (1)); and 3) a physiological interdependence of host and donor immunocompetent cells which precludes reactivity of one against the other. While there is no direct evidence to support any of these hypotheses, the recent work of Miller (17) suggesting a regulatory function for thymocytes and their collateral cells (reported to be relatively radioresistant (18)) makes the last theory somewhat attractive. Thus the residual thymocytes of host origin could govern the reactivity of the donor immunocompetent cells, and as a

result of their interdependence, fashion a state of mutual tolerance.

Host Type Hematopoietic Cells: It has been observed that there is a high proportion of donor type red blood cells in most allogenic chimeras (2,9,10,19). The present results are in agreement with these findings. Host hematopoietic cells were detected in only 5 chimeras of the 25 studied and the remainder, therefore, must have had donor type cells. Whether these chimeras had hematopoietic cells of both donor and host genotypes, such as the "partial chimeras" developed by Popp (10), or a hemopoietic system which was completely of either host or donor type, cannot be determined from these data.

Chimera No. 4 offers a special situation which is of interest. This mouse had host type lymphoid cells but did not exhibit host type hematopo ietic activity (Table I and IV). The C3H-C3D2F_1 chimera which had host hematopoietic cells but apparently no host lymphoid cells is of interest too (Table III). This deployment of the host cells suggests that the hematopoietic and lymphopoietic cell lines may repopulate these chimeras independently of each other, i.e., that two different stem lines are involved. This phenomenon has been noted by others also (10, 20).

Finally, it appears from these data that the irradiated donor bone marrow graft has an initial advantage in repopulating the tissue of the irradiated host, for cells of donor origin, both lymphopoietic and hematopoietic are shown to predominate in most long-lived LAF_1-C3H chimeras.

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1	CG, CBR Combat Developments Agency
1	CO, Chemical Research and Development Laboratories
1	Commander, Chemical Corps Nuclear Defense Laboratory
1	Hq., Army Environmental Hygiene Agency
1	CG., Aberdeen Proving Ground

1	CO, Army Medical Research Laboratory
1	Army Medical Research and Nutrition Laboratory (MEDEN-AD)
1	CO, Army Medical Service Combat Developments Agency
2	Medical Field Service School, Fort Sam Houston (Stimson Lib.)
1	Brooke Army Medical Center (Dept. Prev. Med.)
1	Director, Surgical Research Unit, Fort Sam Houston
1	Director, Walter Reed Army Medical Center
1	Hq., Army Nuclear Medicine Research Detach., Europe
1	CG, Combat Developments Command (CDCMR-V)
1	CG, Quartermaster Res. and Eng. Command
1	Hq., Dugway Proving Ground
3	The Surgeon General (MEDNE)
1	Office of the Surgeon General (Combat Dev.)
1	CG, Engineer Res. and Dev. Laboratory
1	Director, Office of Special Weapons Development
1	CG, Munitions Command
1	CO, Frankford Arsenal
1	CG, Army Missile Command

AIR FORCE

1	Assistant Chief of Staff, Intelligence (AFCIN-3B)
6	CG, Aeronautical Systems Division (ASAPRD-NS)
1	CO, Radiological Health Laboratory Division
1	Director, USAF Project RAND
1	Commandant, School of Aerospace Medicine, Brooks AFB
1	CO, School of Aviation Medicine, Gunter AFB
1	6571st Aeromedical Research Lab., Holloman AFB
1	Radiobiological Laboratory
1	Office of the Surgeon (SUP3.1), Strategic Air Command
1	Office of the Surgeon General
1	CG, Special Weapons Center, Kirtland AFB
1	Director, Air University Library, Maxwell AFB
2	Commander, Technical Training Wing, 3415th TTG
1	Hq., Second Air Force, Barksdale AFB
1	Commander, Electronic Systems Division (CRZT)

OTHER DOD ACTIVITIES

3	Chief, Defense Atomic Support Agency (Library)
1	Commander, FC/DASA, Sandia Base (FCDV)
1	Commander, FC/DASA, Sandia Base (FCTG5, Library)
1	Commander, FC/DASA, Sandia Base (FCWT)
2	Office of Civil Defense, Washington
2	Civil Defense Unit, Army Library
1	Armed Forces Institute of Pathology

20	Armed Services Technical Information Agency
1	Director, Armed Forces Radiobiology Research Institute

AEC ACTIVITIES AND OTHERS

1	Research Analysis Corporation
1	Life Science Officer, AEC, Washington
1	Director, Division of Biology and Medicine
1	NASA, Ames Research Center, Moffett Field
1	Naval Attache, Stockholm (for Commodore Troell)
1	Aerojet General, Azusa
5	Argonne Cancer Research Hospital
10	Argonne National Laboratory
2	Atomic Bomb Casualty Commission
1	AEC Scientific Representative, France
1	AEC Scientific Representative, Japan
3	Atomic Energy Commission, Washington
2	Atomic Energy of Canada, Limited
3	Atomics International
2	Battelle Memorial Institute
1	Borden Chemical Company
3	Brookhaven National Laboratory
1	Chicago Patent Group
1	Colorado State University
1	Columbia University (Rossi)
1	Committee on the Effects of Atomic Radiation
3	Defence Research Member
2	duPont Company, Aiken
1	duPont Company, Wilmington
1	Edgerton, Germeshausen and Grier, Inc., Goleta
1	Edgerton, Germeshausen and Grier, Inc., Las Vegas
2	General Dynamics, Fort Worth
2	General Electric Company, Cincinnati
8	General Electric Company, Richland
1	General Electric Company, St. Petersburg
1	General Scientific Corporation
1	Hughes Aircraft Company, Culver City
1	Iowa State University
1	Journal of Nuclear Medicine
1	Knolls Atomic Power Laboratory
2	Los Alamos Scientific Laboratory (Library)
1	Lovelace Foundation
1	Martin-Marietta Corporation
1	Massachusetts Institute of Technology
1	Mound Laboratory
1	National Academy of Sciences

2	NASA, Scientific and Technical Information Facility
1	National Bureau of Standards (Taylor)
1	National Cancer Institute
1	National Lead Company of Ohio
1	National Library of Medicine
1	New Jersey State Department of Health
1	New York Operations Office
1	New York University (Eisenbud)
1	Office of Assistant General Counsel for Patents
2	Phillips Petroleum Company
4	Pratt and Whitney Aircraft Division
2	Public Health Service, Washington
1	Public Health Service, Las Vegas
1	Public Health Service, Montgomery
1	Sandia Corporation, Albuquerque
1	Union Carbide Nuclear Company (ORGDP)
5	Union Carbide Nuclear Company (ORNL)
1	Union Carbide Nuclear Company (Paducah Plant)
1	United Nuclear Corporation (NDA)
1	U. S. Geological Survey, Denver
1	U. S. Geological Survey, Menlo Park
1	U. S. Geological Survey, Naval Gun Factory
1	U. S. Geological Survey, Washington
1	U. S. Weather Bureau, Washington
1	University of California, Davis
3	University of California Lawrence Radiation Lab., Berkeley
2	University of California Lawrence Radiation Lab., Livermore
1	University of California, Los Angeles
1	University of California, San Francisco
1	University of Chicago Radiation Laboratory
1	University of Hawaii
1	University of Puerto Rico
1	University of Rochester (Atomic Energy Project)
1	University of Tennessee (UTA)
1	University of Utah
1	University of Washington (Donaldson)
1	Wayne State University
1	Westinghouse Electric Corporation (Rahilly)
1	Westinghouse Electric Corporation (NASA)
1	Western Reserve University (Friedell)
25	Technical Information Extension, Oak Ridge

USNRDL

41	USNRDL, Technical Information Division

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Naval Radiological Defense Laboratory
USNRDL-TR-630
MUTUALLY TOLERANT HOST AND DONOR TYPE IMMUNOLOGICALLY COMPETENT CELLS IN MOUSE RADIATION CHIMERAS by W. E. Davis, Jr., M. L. Tyan and L. J. Cole 19 March 1963 26 p. tables 20 refs. UNCLASSIFIED

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1. Transplantation.
2. Immunity.
3. Radiation tolerance.
4. Blood cells.
5. Bone marrow.

I. Davis, W. E.
II. Tyan, M. L.
III. Cole, L. J.
IV. Title.
V. MR005.08-5200.

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Of the remaining 11 chimeras tested, 6 did not exhibit host type immunocompetent cells, while 5 showed questionable host-derived immunological activity. Donor immunocompetent cells were detected in a total of 4 of the 15 LAF_1-C3H chimeras. Host type (i.e., strain A) immunocompetent cells were detected also in two A-LAF_1 radiation chimeras. On the other hand, 10 C3H-$C3D2F_1$ radiation chimeras apparently did not contain host-derived immunogenic cells.

The presence of hematopoietic cells of host origin was detected in 4 out of 15 LAF_1-C3H radiation chimeras. Host-derived hematopoietic cells were not detected in the A-LAF_1 radiation chimeras, and only 1 of the 10 C3H-$C3D2F_1$ radiation chimeras had host hematopoietic tissue. Therefore, within the limits of the test system employed the hematopoietic cells in the remaining chimeras must therefore be predominantly of donor origin.

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